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Spiders in snail shells in different Hungarian habitats

by
Cs. Szinetár, Zs. Gál and J. Eichardt
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Abstract: With the aim of examining the spider fauna, 7197 empty snail shells have been collected and examined from 12 collecting localities in Hungary. The 723 spiders found represented at least 37 species. Beside the 6 most frequent taxa *(Pellenes nigrociliatus, Euryopis quinqueguttata, Heliophanus* spp., *Euophrys* spp., *Pellenes tripunctatus)* several rare species were also found. Among these, *Ballus rufipes* (Simon,1868) and *Euophrys aperta* Miller, 1971 are new to the Hungarian fauna.
Keywords: spiders, overwintering, empty snail shells

Introduction

Numerous examples are known about arthropods using empty snail shells. For example, in the case of hermit crabs (*Paguridae*), mason bees (*Osmia* spp.) as well as caddis-flies (*Trichoptera*), this phenomenon is well known. In the case of some tropical spiders, there were reports on permanent snail shell and spider relation (Horn 1980).

There is only a few data in the European literature on spiders living in snail shells. The majority of the references relate to the water spider (*Argyroneta aquatica*), in which wintering in empty snail shells is a frequent phenomenon (Wagner 1894, Lampert 1904, Wesenberg-Lund 1939, Horn 1980). Some further publications are dealing with the relation between empty snail shells and jumping spiders (*Salticidae*) (Bellmann 1976, 1991, Horn 1980, Bauchhenss 1995). Studies of Horn (1980) and Bauchhenss (1995) showed that in the grassy associations where the empty shells of some snail species are occurring in high number, high percentage of shells (10-40%) are occupied by spiders. Among these, some jumping spider species (*Salticidae*) are the most frequent. Horn (1980) performed observations beyond the wintering period too and studied the breeding behavior of *Pellenes nigrociliatus* connected to the snail shells.

Numerous xerothermic ecosystems are known in Hungary, where some thermophil snail species occur in large numbers. In this respect the most characteristic are the south-facing rocky swards on southern slopes of our mountains as well as the sandy grassland prairies of the Great Hungarian Plain.

In these grass communities the empty snail shells can be found during the whole year on the soil surface. The most frequent species are *Zebrina detrita* and *Helicella obvia*. In the light of the above mentioned facts, it seemed promising to collect data on spider occupancy of shells, especially because such data collection has not been carried out in our country yet.

We wanted to answer the following questions:

1. In what extent are the spiders using empty snail shells as shelters during winter?
2. Are the spiders living in snail shells only during the winter?
3. What kind of spider species could be collected effectively this way?
4. Which are those habitats where this method could be used effectively for faunistical data collection?

Material and methods

We collected samples from the snail shells lying on the soil surface. Considering that the snail shells are to be found with a different frequency at the different habitats, the volume of the samples has been different at each habitat. Where it was applicable, we collected in each sample at least 100 snail shells selected at random. In the case of some bigger habitats, we collected more samples,

Table 1. List of samples with information on habitats, and number of specimens of snails and spiders found. (Habitats: A: dolomite rock grass and slope steppe B: limestone rock grass and slope steppe; C: open sandy prairie grass; D: riverside deposits; E: silicate rock grass and slope steppe; Gastropods: G 1: *Helicella obvia*; G 2: *Zebrina detrita*; G 3: *Cepaea vindobonensis*; G 4: *Helix pomatia*; G 5: *Viviparus contectus*; G 6: *Lymnaea stagnalis*; G 7: *Planorbarius corneus*; G 8.: *Arianta arbustorum*;

Sample	Locality	UTM code	Date	Habitat	G 1	G 2	G 3	G 4	G 5	G 6	G 7	G 8	ΣG	ΣSpider
1.	Sas-hegy	CT 56	30.11.'95	A	265	361							626	53
2.	Szársomlyó	BR 98	03.03.'96	B	201	544							745	98
3.	Nagy-Eged	DU 50	08.03.'96	B	16	-29							-45	2
4.	Gete-hegy	CT 28	17.03.'96	A	66	102							168	16
5.	Fülöpháza	CS 89	16.03.'96	C	820								820	221
6.	Szársomlyó	BR 98	22.03.'96	B	218	522							740	10
7.	Mecsér	XN 89	24.03.'96	D					68	13	15	21	117	2
8.	Budaörs	CT 46	10.04.'96	A	36	147							183	27
9.	Ökör-hegy	CS 27	20.05.'96	C	183		3						186	2
10.	Fülöpháza	CS 89	20.05.'96	C	389	1	10						400	24
11.	Sas-hegy	CT 56	15.11.'96	A	168	7							175	28
12.	B. füred	YN 10	24.11.'96	A	202	190							392	33
13.	Letkés	CU 30	22.02.'97	B		50							50	1
14.	Strázsa-h.	CT 38	23.02.'97	B	741	16							757	71
15.	Mecsér	XN 89	01.03.'97	D					57	8	24	16	105	1
16.	Ság-hegy	XN 63	02.03.'97	E	10		12	6					28	1
17.	Sas-hegy	CT 56	04.03.'97	A	9	183	5	12					209	27
18.	Strázsa-h	CT 38	08.03.'97	B	7	187							194	14
19.	Ság-hegy	XN 63	09.03.'97	E	134		103						237	8
20.	Strázsa-h	CT 38	10.03.'97	B	89	51							140	2
21.	Budapest	CT 56	02.04.'97	B				1					1	1
22.	Ság-hegy	XN 63	12.04.'97	E	40		96	2					138	2
23.	Sas-hegy	CT 56	17.04.'97	A	7	172							179	12
24.	Strázsa-h	CT 38	01.02. '98	B	303	259							562	67
					3904	2821	229	21	125	21	39	37	7197	723

simultaneously. The collected snails were placed in sealed bags. The snail shells were broken and examined in the laboratory. Until the beginning of the examination, we stored the samples in refrigerator. However, at sorting, a part of the spiders were already outside of the snail shells. Wherever it was possible , we made a note of the spider's snail shell. We kept a part of the young specimens at room temperature and feed them with *Drosophila melanogaster* in order to let them reach maturity for the sake of identification. On some collecting localities we carried out collections and observations in spring, and early summer in order to find out which species are using the snail shells beyond the winter period. We have performed the collections – except one locality – in xerothermic grasslands. That is, in dolomite, limestone and silicate rocky swards as well as in prairie like grassland on calcareous sand. Besides, we examined twice the water snail shells present in large numbers in the riverbank deposits.

The collection of the studied material was carried out between 30th November 1995 and 1st February 1998, at 12 localities in Hungary, in total on 24 occasions. The collections are listed in Table 1, according to the dates and place. In the table the number of collected snail and spider specimens is indicated. In addition to the authors, the collections have been performed by a number of persons. The following abbreviations are used hereinafter for the collectors' names: B = N. Bauer, F = B. Fazekas, G = Zs. Gál, Gr = P. Grúber, H = R. Horváth, J = J. Barna, K = H. Kovács, M = J. Mészáros, P = F. Pál Szabó, Sz = Cs. Szinetár, Z = J. Zámbó

Results

During the study, 7197 snail shells have been examined. From these, 723 spiders came to the light which represented 13 families, 30 genus and at least 37 species. Mature specimens of 21 species were found. The majority of these was collected in subadult state and reached the maturity during the period they were kept in the laboratory.

List of species

Theridiidae

Euryopis quinqueguttata Thorell, 1875
2 ♀, 6 ♂, 3 juv. Bp., Sas-hegy, 30.11.1995, leg. Sz. 8 ♀, 22 ♂, 16 juv. Nagyharsány, Szársomlyó, 03.03.1996, leg. H.1 ♀, 2 ♂, 1 juv. Gete-hegy, Gerecse, 17.03.1996, leg. B. 1 ♀ Budaörs, 10.04.1996, leg. G. 1 ♂ Letkés, Börzsöny, 22.02.1997, leg. F.; 1 ♂, 7 juv. Esztergom, Kis-Strázsa-hegy, 23.02.1997, leg. J.; 3 ♂, 3 juv. Budapest, Sas-hegy, 04. 03. 1997, leg. Sz.; 2 ♀ Budapest, Sas-hegy, 17.04.1997, leg. Sz.; 1 juv. Balatonfüred, 20.04.1997, leg. M.; 1 ♀ Esztergom, Strázsa-hegy, 01.02.1998, leg. B.;
Neottiura (*bimaculata* (Linnaeus, 1767)) sp.
1 juv. Budapest, Sas-hegy, 04.03.1997, leg. Sz.;
Steatoda albomaculata (De Geer, 1778)
2 juv. Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Theridion sp.
1 juv. Bikács, Ökör-hegy, 20.05.1996, leg. G.;

Linyphiidae

Linyphiidae sp.
1 juv. Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Linyphiidae sp.
1 ♀ Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;

Tetragnathidae

Pachygnatha clercki Sundevall, 1823
1 ♀ Szigetköz, Mecsér, 24.03.1996, leg. Sz.;

Lycosidae

Alopecosa sp.
1 juv. Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Pardosa sp.
2 juv. Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Pirata piraticus (Clerck, 1757)
1 ♀ Szigetköz, Mecsér, 24.03.1996, leg. Sz.;

Amaurobidae

Amaurobius erberi (Keyserling, 1863)
1 ♂ Budapest, Sas-hegy, 04.03.1997, leg. Sz.;

Titanoecidae

Titanoeca sp.
1 juv. Celldömölk, Ság-hegy, 12.04.1997, leg. Z.;

Oxyopidae

Oxyopes sp.
1 juv. Fülöpháza, 16.03.1996, leg. P.;

Clubionidae

Cheiracanthium erraticum (Walckenaer, 1802)
1 ♂ Esztergom, Kis-Strázsa-hegy, 23.02. 1997, leg. J.;
Cheiracanthium pennyi O.P.-Cambridge, 1873
1 ♂ Fülöpháza, 16.03.1996, leg. P.;
Cheiracanthium sp.
2 juv. Budapest, Sas-hegy, 30.11.1995, leg. Sz.; 1 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H.; 6 juv. Fülöpháza, 16.03.1996, leg. P.; 5 juv. Esztergom, Kis-Strázsa-hegy, 23.02.1997, leg. J.;
Clubiona genevensis L. Koch, 1866
1 ♂ Budaörs, 10.04.1996, leg. G.;
Clubiona phragmitis C.L. Koch, 1843
1 ♀ Mecsér, Szigetköz, 01.03.1997, leg. Sz.;

Zodariidae

Zodarion (*rubidum* Simon, 1914) sp.
1 juv. Budapest, Sas-hegy,30.11.1995, leg. Sz.;

Gnaphosidae

Haplodrassus signifer (C.L.Koch, 1839)
1 ♀, 1♂ Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.; 1 ♂ Celldömölk, Ság-hegy, 09. 03. 1997, leg. Z.;
Haplodrassus sp.
1 juv. Budapest, Sas-hegy, 30.11.1995, leg. Sz.;
Phaeocedus (*braccatus* (L.Koch, 1866)) sp.
1 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H.;
Zelotes sp.
2 juv. Eger, Nagyeged, 08.03.1996, leg. G.;
Gnaphosidae sp.
1 juv. Budapest, Sas-hegy, 17.04.1997, leg. Sz.;

Zoridae

Zora sp.
1 juv. Esztergom, Strázsa-hegy, 01.02.1998, leg. B.;

Thomisidae

Xysticus kochi Thorell, 1872
1 ♂ Budapest, Sas-hegy, 30.11.1995, leg. Sz.; 1 ♂ Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;

Salticidae

Ballus rufipes (Simon, 1868)
1 ♂ Esztergom, Strázsa-hegy, 08.03.1997, leg. Gr.;
Euophrys aperta Miller, 1971
1 ♀ Esztergom, Strázsa-hegy, 08.03.1997, leg. Gr.;
Euophrys sp.
6 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H.; 1 juv. Nagyharsány, Szársomlyó, 22.03.1996, leg. K.; 1 juv. Budaörs, 10. 04. 1996, leg. G.; 1 juv. Esztergom, Kis-Strázsa-hegy, 23.02.1997, leg. J.; 1 juv. Budapest, Sas-hegy, 04.03.1997, leg. Sz.; 1 juv. Esztergom, Strázsa-hegy, 08.03.1997, leg. Gr.; 1 juv. Esztergom, Strázsa-hegy, 01. 02. 1998, leg. B.;
Evarcha laetabunda (C.L.Koch, 1846)

1 ♂ Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Heliophanus cupreus (Walckenaer, 1802)
1 ♀, 1♂ Celldömölk, Ság-hegy, 09.03.1997, leg. Z.; 1 ♂ Celldömölk, Ság-hegy, 12. 04. 1997, leg. Z.;
Heliophanus flavipes Hahn, 1832
1 ♂ Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Heliophanus kochii Simon, 1868
1 ♂ Nagyharsány, Szársomlyó, 03.03.1996, leg. H.;
Heliophanus lineiventris Simon, 1868
1 ♂ Budapest, Sas-hegy, 30.11. 1995, leg. Sz.; 1♂ Budapest, Sas-hegy, 15.11.1996, leg. Sz.; 1 ♂ Budapest, Sas-hegy, 17.04.1997, leg. Sz.;
Heliophanus sp.
1 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H.; 1 juv. Budaörs, 10.04.1996, leg. G.; 1 juv. Budapest, Sas-hegy, 15. 11. 1996, leg. Sz.; 1 juv. Balatonfüred, 24. 11. 1996, leg. M.; 7 juv. Esztergom, Kis-Strázsa-hegy, 23.02.1997, Leg. J.; 3 juv. Esztergom, Strázsa-hegy, 08.03.1997, leg. Gr.; 1 juv. Celldömölk, Ság-hegy, 09.03.1997, leg. Z.; 1 juv. Budapest, Sas-hegy, 17.04.1997, leg. Sz.;
Myrmarachne formicaria (De Geer, 1778)
1 ♀ Budapest, Füvészkert, 07.04.1997, leg. Sz.;
Pellenes nigrociliatus (Simon, 1875)
33 juv. Bp., Sas-hegy, 30.11.1995, leg. Sz. 40 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H. 12 juv. Gete-hegy, Gerecse, 17.03.1996, leg. B. 213 juv. Fülöpháza, 16. 03. 1996, leg. P. 9 juv. Nagyharsány, Szársomlyó, 22.03.1996, leg. K. 23 juv. Budaörs, 10.04.1996, leg. G.; 1 ♂ Bikács, Ökör-hegy, 20.05.1996, leg. G.; 16 ♀, 6 ♂, 1 juv. Fülöpháza, 20.05.1996, leg. G.; 22 juv. Budapest, Sas-hegy, 15.11.1996, leg. Sz.; 31 juv. Balatonfüred, 24.11.1996, leg. M.; 34 juv. Esztergom, Kis-Strázsa-hegy, 23.02.1997, leg. J.; 1 juv. Celldömölk, Ság-hegy, 02. 03. 1997, leg. Z.; 18 juv. Budapest, Sas-hegy, 04. 03.1997, leg. Sz.; 7 juv. Esztergom, Strázsa-hegy, 08.03.1997, leg. Gr.; 4 juv. Celldömölk, Ság-hegy, 09.03.1997, leg. Z.; 2 juv. Esztergom, Kis-Strázsa-hegy, 10.03.1997, leg. B.; 4 juv. Budapest, Sas-hegy, 17. 04. 1997, leg. Sz.; 64 juv. Esztergom, Strázsa-hegy, 01.02.1998, leg. B.;
Pellenes tripunctatus (Walckenaer, 1802)
3 juv. Bp., Sas-hegy, 30.11.1995, leg. Sz. 4 juv. Budapest, Sas-hegy, 15.11.1996, leg. Sz.; 1 juv. Esztergom, Strázsa-hegy, 08. 03. 1997, leg. Gr.; 3 juv. Budapest, Sas-hegy, 17.04.1997, leg. Sz.;
Sitticus penicillatus (Simon, 1875)
1 ♀ Nagyharsány, Szársomlyó, 03.03.1996, leg. H.;
Sitticus (*saltator* (O.P. -Cambridge, 1868)) sp.
3 juv. Esztergom, Kis-Strázsa-hegy, 23. 02. 1997, leg. J.;
Sitticus sp.
1 juv. Nagyharsány, Szársomlyó, 03. 03. 1996, leg. H.;
Salticidae sp.
1 juv. Balatonfüred, 24.11.1996, leg. M.;

Discussion

More than 10% of the snail shells were inhabited (10.04%). This value in the case of some habitats and samples collected in the winter period was much higher. The highest value (26.95%) has been found in the specific sandy prairie grasses in the Danube-Tisza Mid-region. In the winter of 1996, the area was covered with snow for several weeks. The collection of snail shells was carried out immediately after the snow thawing. In the same area, we detected an inhabitation of 6% in May. The jumping spiders represented 83% of the total material. Apart from them, only a characteristic snail shell inhabitant theridiid species (*Theridiidae*), *Euryopis quinqueguttata* had a significant abundance (11.2%). Attention

Table 2. The 6 most abundant spider taxa in snail shells (Hungary, 1995-98).

Taxa	♀	♂	juv.	Σ	Relative frequency	Number of localities
Pellenes nigrociliatus	16	7	518	541	0.748	10
Euryopis quinqueguttata	15	35	31	81	0.112	8
Heliophanus spp. (min.4sp.)	1	7	16	24	0.033	7
Cheiracanthium spp .(min 2 sp.)	–	2	14	16	0.022	4
Euophrys spp.	1	–	12	13	0.018	6
Pellenes tripunctatus	–	–	11	11	0.015	2
Σ	33	51	602	686	0.95	–

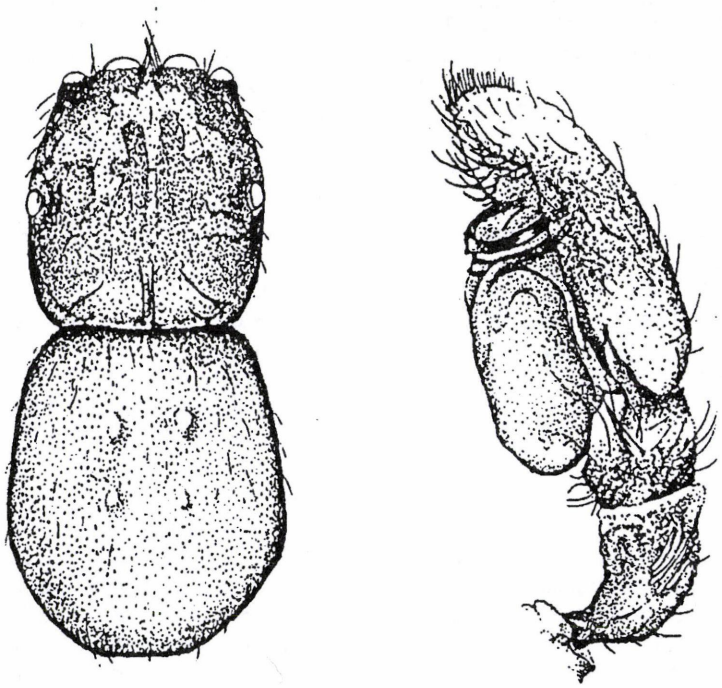

Figure 1. The body of the *Ballus rufipes* (Simon, 1868) in a dorsal view, without legs and the left palp of the male in lateral view

should be paid to the *Cheiracanthium* species which was found on four collecting localities and amounted to 2.2% of the sampling. Among the absolutely dominant jumping spiders, *Pellenes nigrociliatus* has to be mentioned first. The relation of the species with the empty snail shells was already known. Its presence could be demonstrated on 10 areas. In the winter period, only its juvenile specimens were found. In May, we succeeded to find mature specimens on three areas (Mezőföld, Bikács; Danube-Tisza Mid-region, Fülöpháza, Budapest, Sas-hegy). According to the description of Horn (1980), the mature females are living in snail shells hung up on the plants. They are laying the cocoons in these shells and they remain around to guard them. During the summer, the snail shells hung at 1-3 cm above the soil can be continuously observed. A strong web fastens these shells to the plants. In May, we managed to collect matured male specimens together with their shells on the sandy area at Fülöpháza. It is likely that they are remaining in the snail shells until reaching the maturity. *Pellenes tripunctatus* has a much less frequent occurrence than the former species. We have caught juvenile specimens exclusively. These can be clearly separated from the former species, based on their pattern and size. (The length of the carapax in the case of *Pellenes nigrociliatus* 0.7-2.1 mm, while at *Pellenes tripunctatus*, 1.5-2.6 mm). Among the jumping spiders, several species are interesting from faunistical point of view. Two species, new to the Hungarian fauna were found. We found a subadult specimen of *Ballus rufipes* in the shell of *Zebrina detrita* collected from the lime rock grasses (Fig. 1). We managed to grow it up to maturity in laboratory by feeding it with vinegar flies. The species shows a typical South-European distribution (Alicata & Cantarella 1987). In addition to the South-European distribution areas, some places of occurrence are known in Germany (Bauchhenss 1992, 1995). The coloring of the species is strikingly different from the color of *Ballus chalybeius*, being wide-spread in Hungary. Its carapax and abdomen is equally black, the proximal part of the legs are coral-red. The palp of the male resembles that of *Ballus chalybeius* but the hair on the cymbium and legs are different. In the case of *B. rufipes* the dense hair on the tip of the cymbium consists of hairs of even length, while in the case of the *B. chalybeius,* on the tip of the cymbium there are two hair fields with differently sized hairs. From these, the shorter hair can be observed at the end of the cymbium. On the exterior side of the palp femur at *B. rufipes*, a small spot of strong white hairs can be observed. Alicata & Cantarella (1987) as well as Bauchhenss (1992) have described numerous distinguishing marks of the two *Ballus* species.

A female specimen of *Euophrys aperta* has been found on the same place and date as the previous species. It is also a rare species with South-European distribution (Heimer & Nentwig 1991). There were no published data in Hungary but a female specimen was caught in 1994 (Nagykovácsi, Julianna-major, 30th April 1994, F. Samu, personal communication). The further *Euophrys* specimens found there were young and the attempt to rear them was unsuccessful. Presumably, the 12 young specimens found on six collecting places, represented several species. Other authors also mention further jumping spiders, *Sitticus penicillatus* and *Myrmarachme formicaria*, as being species that winter in snail shells (Horn 1980, Bellmann 1991, 1992, Bauchhenss 1995). It has to be mentioned that the *Heliophanus* genus was represented by at least four species and was present at seven collecting places. In spite of the relatively small specimen number, in the case of certain species, this choice of wintering place could be typical. Three male specimens of *Heliophanus lineiventris* were found on the same collecting place on three different collecting dates. The caught animals were found in *Helicella obvia* shells closed with dense web. Horn (1980) in the case of the Austrian (Illmitz, 19th March 1976) collection deemed typical the occurrence of the

Heliophanus species. As a common species *Heliophanus flavipes* can be mentioned. It can be seen in Table 2 that *Euryopis quinqueguttata* is the second most frequent snail shell inhabitant species. It amounted to 11% of the whole sampling and was present on 8 collecting places. It is the only species in which the mature specimens were found in a bigger number than the juveniles. The mature specimens were in majority both in autumn and spring.

Based on our results we can state that the empty snail shells collected in the winter period from the scattered vegetation of the thermophil grass associations could be suitable for the assessing showing the spiders wintering in them. On average, we found spiders in 10% of the snail shells. *Pellenes nigrociliatus* is living in snail shells even in the summer during the reproduction and offspring rearing period. Apart from the species inhabiting frequently the snail shells, this method could be suitable for collecting the rare species. Collecting the animals alive enables the collector to rear them, thus obtaining faunistically assessable data. If the animals are not required for collection supplement, then they can be released. The majority of species occurring with small specimen numbers was presumably found only at random (e.g. Lycosidae). In the same time in the case of certain species, which are not related in the former literature as having this behavior, it is likely the facultative snail shell wintering (e.g. *Cheiracanthium pennyi*). Decision regarding this, may be made only after further examinations.

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Authors' address: Dr. Csaba Szinetár,
Zsófia Gál,
János Eichardt
Department of Zoology,
Berzsenyi College
H-9701 Szombathely,
Károlyi G. tér 4.
Hungary
E-mail: szcsaba@fs2.bdtf.hu